

# TROPICAL STORM SARAH (09W)

The summer monsoon was well established and had stronger than normal low-level westerlies from the Caroline to the Marshall Islands by mid-July. From the 21st of July onward, the conditions were ripe for cyclogenesis. After daily mention in the Significant Tropical Weather Advisory (ABPW PGIW) and several false alarms, a Tropical Cyclone Formation Alert (TCFA) was issued for a rapidly developing area of convection in the Philippine Sea 420 nm (778 km) north of Belau.

The aircraft reconnaissance flight investigating this disturbed area at 300152Z located a weak, low-level circulation center with maximum surface winds of 18 kt (9 m/sec) and a minimum sea-level pressure (MSLP) of 1001 mb. The first warning for Tropical Depression 09W followed at 301200Z as convection and winds increased on the south side of the vortex.

Subsequent intensification of this system was masked from satellite imagery by the heightened convective activity in the monsoonal westerlies.

Aircraft reconnaissance into the tropical cyclone at 311525Z found 40 kt (21 m/sec) surface winds, which prompted the upgrade to Tropical Storm Sarah. During this period, the tropical cyclone's west-northwestward movement slowed and the system, which appeared to be following an under-the-ridge scenario, continued to consolidate.

Later aircraft reconnaissance at 3112138Z and 010009Z confirmed the slowing trend and the Aerial Reconnaissance Weather Officer (ARWO) reported that multiple circulation centers might be present. Additionally, the ARWO estimated the ring of maximum surface winds as nearly symmetrical with slightly weaker winds in the northern semicircle displaced 20 to 60 nm (32 to 96 km) from the center.

As Sarah moved closer to the island of Luzon, it became increasingly more difficult to locate the circulation center. The major convective area shifted to the northwest quadrant (see Figure 3-09-1). Aircraft reconnaissance at 011300Z (Figure

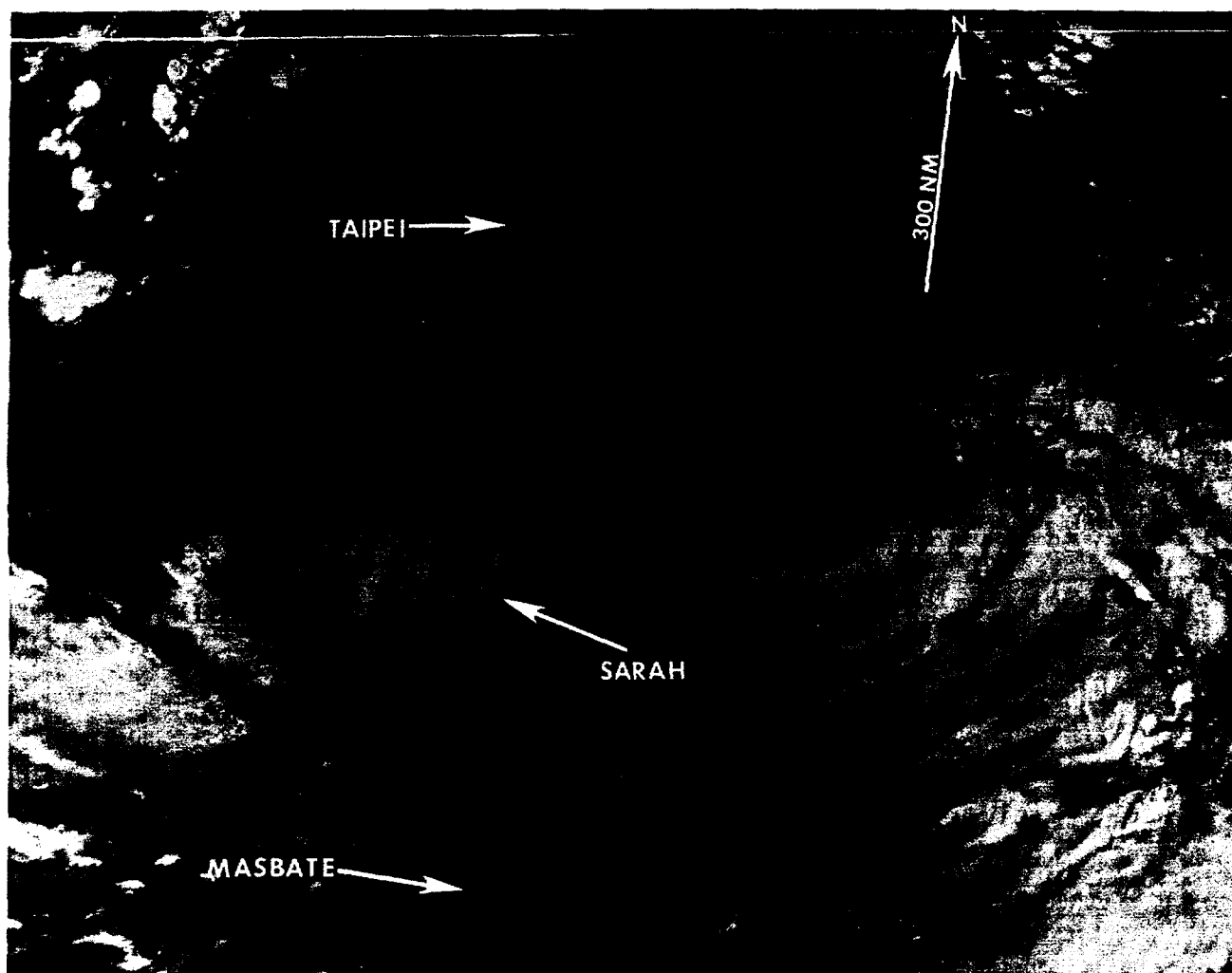


Figure 3-09-1. "Where is Sarah?" That was the question when this image was received. The trend from previous satellite imagery was for the deep convection to continue westward movement across northern Luzon appears to be maintained (010608Z August NOAA visual imagery).

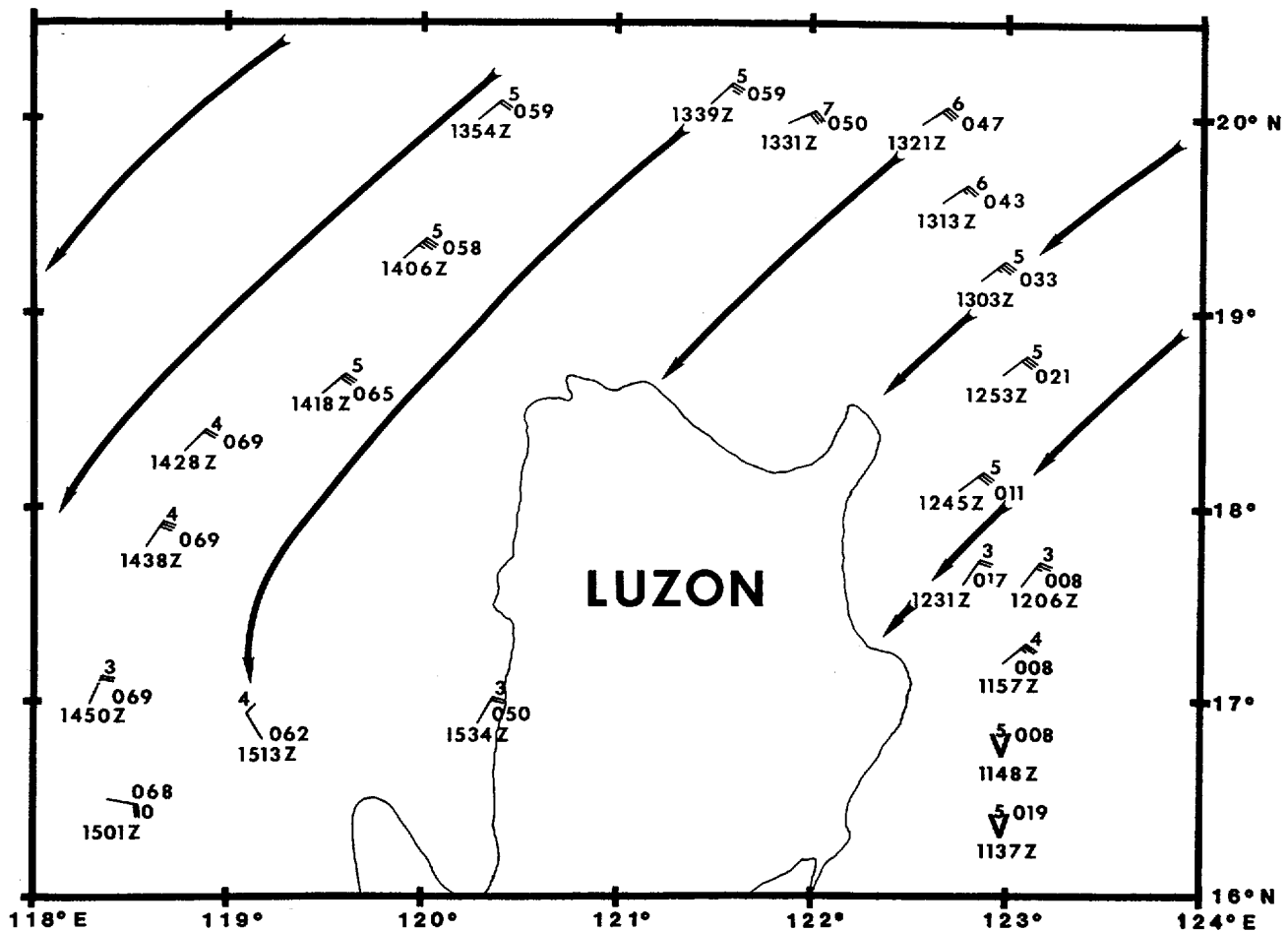


Figure 3-09-2. A plot of the 011300Z August aircraft reconnaissance mission around northern Luzon. These data imply that the low-level circulation in the monsoon trough (i.e., Sarah) may have remained in the Philippine Sea.

3-09-2) flew around northern Luzon and detected only broadscale northeasterly flow without a trace of a low-level circulation center. These northeasterly winds should have provided a valuable clue as to the location of Sarah. (In retrospect, it took more than 24-hours to get the forecast back on the right track.) In the interim, the persistent deep cloudiness across northern Luzon as viewed by the meteorological satellite imagery implied that Sarah was continuing into the South China Sea and towards mainland China. The dynamic guidance provided by Nested Tropical Cyclone Model (NTCM) and One-Way Interactive Tropical Cyclone Model (OTCM) endorsed this movement into the South China Sea.

Again, aircraft reconnaissance between 012100Z and 020000Z was unable to locate a Sarah. This time the flight was west of Luzon in the South China Sea. An aircraft mission previously scheduled to investigate a TCFA area northeast of Luzon, however, did find Sarah in the Philippine Sea. Satellite imagery after 012100Z also showed a reorganization of deep convection east of Luzon. This resulted in a relocation and an abrupt change in forecast philosophy. No longer was Sarah following the under-the-ridge scenario into the South China Sea,

but now was moving northeastward (Figure 3-09-3).

After 030600Z August, Sarah started accelerating toward the northeast in response to increasing westerly wind flow aloft. By 050000Z, the system moved to a position east of the island of Honshu and transitioned to an extratropical cyclone.

Reanalyses of aircraft, satellite, radar and conventional data after-the-fact revealed the following. As Sarah approached northern Luzon, the upper-level circulation center became displaced from the low-level center and moved across the mountainous terrain of the island and dissipated in the South China Sea. The residual low-level vortex, which was weak and difficult to locate, remained east of Luzon in the active monsoon trough. The monsoon trough changed its orientation gradually from east-west to northeast-southwest, as Sarah reintensified and moved northeastward. The aircraft mission at 011300Z (Figure 3-09-2) was a key piece of data in reconstructing what happened in this difficult situation. The broad northeasterly flow across northern Luzon implied that Sarah remained in the Philippine Sea and was masked by the monsoon trough and vigorous convection closeby.

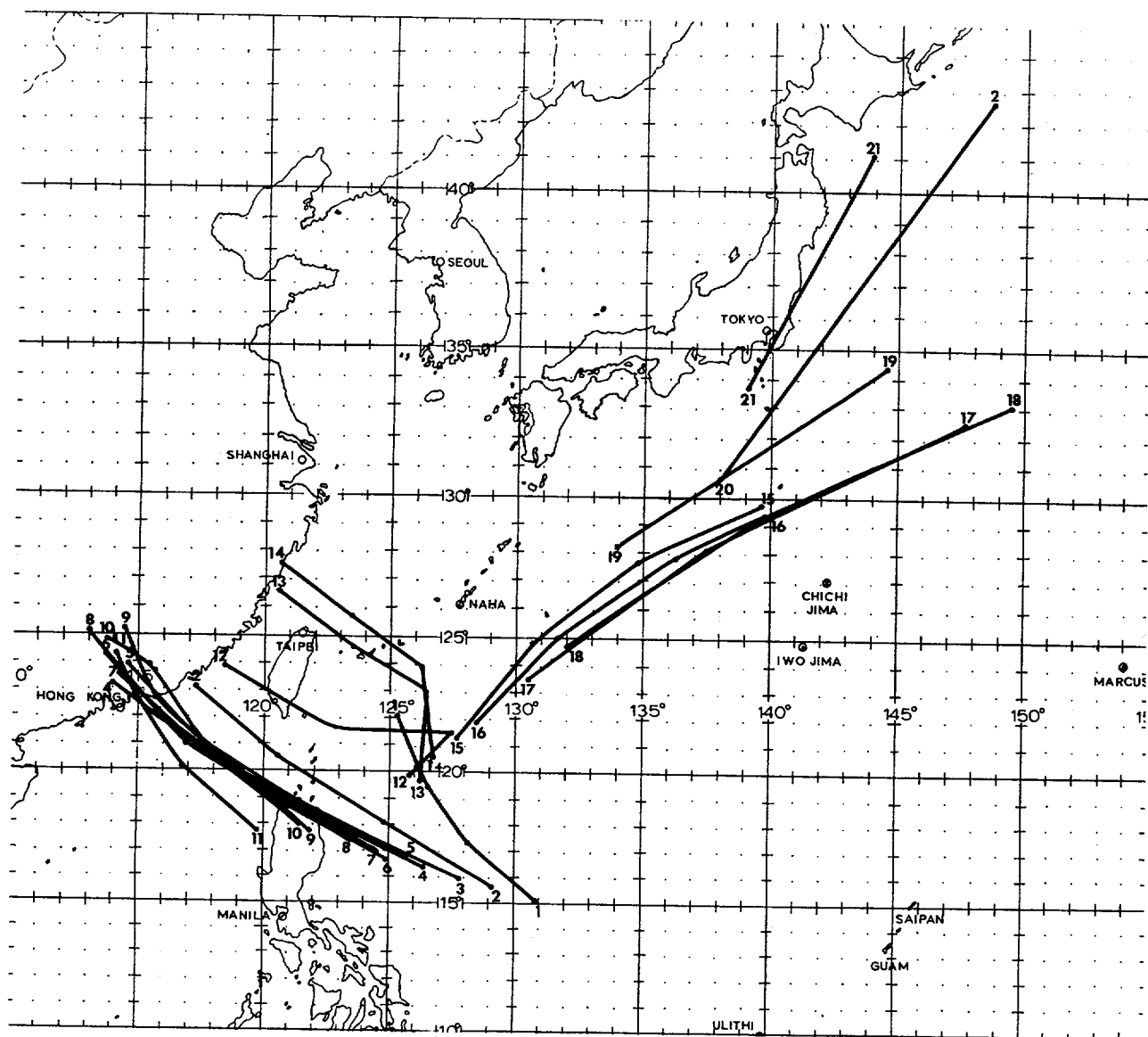


Figure 3-09-3. Plots of the forecast tracks for Sarah. Note the abrupt change between warnings 11 and 15. The difficulty in locating the low-level circulation center and understanding the changing synoptic situation prolonged the time (warnings 9 through 14) it took to get the forecasts back on the right track.